

Trace element analysis in quartz by using laser ablation ICP-MS: A tool for deciphering magma evolution

M. SVOJTKA*, L. ACKERMAN AND K. BREITER

Institute of Geology, Academy of Sciences CR, 16500 Praha 6, Czech Republic (*correspondence: svojtka@gli.cas.cz)

Quartz is one of the most abundant mineral in the Earth's continental crust and is a common and most resistant rock-forming mineral in silica-oversaturated rocks. During post-magmatic and metamorphic alterations, trace elements are relatively stable in quartz crystal lattice. We have used laser ablation ICP-MS technique to (1) evaluate the chemical composition of igneous quartz from two comagmatic granitic and rhyolitic suites and (2) correlate cathodoluminescence internal structures and trace element patterns in quartz to define relations of element chemistry and zonation.

Internal structure of quartz grains was studied by cathodoluminescence (CL) on the electron microprobe. Trace element (Li, Be, B, Rb, Sr, Ba, Pb, Ge, Al, P, Ti, Cr, Mn) concentrations were measured using a New Wave UP-213 laser ablation system connected with sector-field single collector ICP-MS (Thermo Element 2). Laser was fired at repetition rate of 20 Hz and energy of 8-10 J/cm². All data were calibrated against the external standard NIST SRM612 glass and silica contents were used for internal standardization. Time-resolved signal data were processed using the Glitter software; caution was taken to constrain the signal to chemically homogeneous parts of the crystals and to avoid any inclusions and inhomogeneities that can be potentially present in the analysed.

Our pilot samples were taken from the late-Variscan magmatic system of the A-type in eastern Krušné hory Mts. (N Bohemian Massif). The rhyolite samples from borehole Mi-4 represent evolution of the Altenberg-Teplice caldera, whereas the granite sample from borehole CS-1 document vertical zonation of the comagmatic Cínovec pluton.

Cathodoluminescence images of quartz grains (crystals and their fragments) from the rhyolite show distinct domains with a characteristic bright and dark luminescence: the cores are dark (poor in Ti, and enriched in Al and Ge), whereas rims are bright (rich in Ti and poor in Al). Quartz grains from granites are homogeneous, without any CL zonation. Evolution from the deeper protolithionite to the upper zinnwaldite granite is documented by increase of Al, Ge, B, Sr, Ba, and decrease of Ti-contents in quartz.

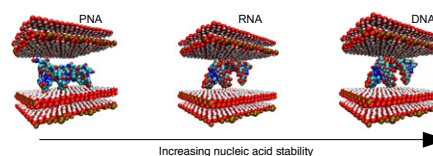
Computer simulation of clay mineral – biomolecule interactions

JACOB B. SWADLING¹, PETER V. COVENEY^{1*}
AND H. CHRISTOPHER GREENWELL²

¹Centre for Computational Science, Department of Chemistry, University College London, WC1H 0AJ, UK
(*correspondence: p.v.coveney@ucl.ac.uk)

²Department of Earth Science, Durham University, Durham, DH1 3LE, UK

We show simulations of various 25-mer sequences of single stranded RNA, in bulk water and with aqueous montmorillonite clay [1]. Over timescales of only a few nanoseconds, specific RNA sequences fold to characteristic secondary structural motifs, which do not form in the corresponding bulk water simulations. Our simulations show that, in aqueous Ca²⁺ environments, RNA can tether to the clay surface through a nucleotide base leaving the 3' end of the strand exposed, providing a mechanism for the regiospecific adsorption and elongation of RNA oligomers on clay surfaces.



We study the structural stability of three different nucleic acids, intercalated at varying degrees of hydration within a magnesium aluminum layered double hydroxide (LDH) mineral host and free in aqueous solution [2]. The nucleotides investigated are ribose nucleic acid (RNA), deoxyribose nucleic acid (DNA), and peptide nucleic acid (PNA), all in duplex form. Our simulations show that DNA has enhanced Watson-Crick hydrogen-bonding when intercalated within the LDH clay layers, compared with intercalated RNA and PNA, whilst the reverse trend is found for the nucleic-acids in bulk water. The tendency for LDH to alter the stability of the three nucleic acids persists for higher temperature and pressure conditions. These results suggest that a mineral based origin of life may have favored DNA as the information-storage biomolecule over potentially competing RNA and PNA, providing a route to modern biology from the RNA world.

[1] J. B. Swadling, P. V. Coveney, & H. C. Greenwell. (2010) *J. Am. Chem. Soc.* **132**, 13750–13764. [2] J. B. Swadling, P. V. Coveney, & H. C. Greenwell. (2010, submitted).